33. $\frac{dy}{dt} = y(1-y)$ $y(0) = .1$ $y = \frac{m}{1+Ae^{-kmt}}$

$\frac{dP}{dt} = kP(m-P)$ $y = \frac{1}{1+9e^{-t}}$ $m = 1$ $k = 1$

$A = \frac{1-.1}{.1} = 9$

$km = 1$

35. $\frac{dy}{dx} = \sin^3 x$ $y = 5$ $x = 4$

$y = \int_a^x \sin^3 t \, dt$

$\frac{dy}{dx} = \sin^3 x$ $y = \int_4^x \sin^3 t \, dt + 5$

F. T. C. $\frac{d}{dx}\int_a^x f(t)\,dt = f(x)$

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57. $L(x)$

$\frac{dL}{dx} = -kL$ $x = 18$ = Half life $L = \frac{1}{2}L_0$

$L = L_0\left(\frac{1}{2}\right)^{\frac{x}{H}}$

$X = ?$ $L = \frac{1}{10}L_0$

$\frac{1}{10}X_0 = X_0\left(\frac{1}{2}\right)^{\frac{x}{18}}$

$\ln .1 = \frac{x}{18}\ln .5$

$x = \frac{\ln .1}{\ln .5} \cdot 18 = 59.79$

$H = \frac{\ln 2}{k}$

$y = y_0 e^{-kt}$ $k = \frac{\ln 2}{H}$

$y_0\left(e^{-\frac{\ln 2}{H}}\right)^t$

$y_0\left(e^{\ln 2}\right)^{\frac{t}{H}}$

$y_0\left(\frac{1}{2}\right)^{\frac{t}{H}}$

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58. $\frac{dy}{dt} = k\left(\frac{A}{V}\right)(c-y)$ y = conc.

$\int \frac{dy}{c-y} = \int \frac{kA}{V}\,dt$ $\int \frac{1}{c-y}\,dy = \frac{kA}{V}\int 1\,dt$

$-\ln|c-y| = \frac{kA}{V}\cdot t + c_1$

$\ln|c-y| = -\frac{kA}{V}t + c_1$

$c - y = e^{-\frac{kA}{V}t + c_1} = e^{-\frac{kA}{V}t} \cdot e^{c_1}$

$y(0) = y_0$

$c - y = c_2 e^{-\frac{kA}{V}t}$ $y = c - c_2 e^{-\frac{kA}{V}t}$

initial conditions $t = 0$ $y = y_0$ $y_0 = c - c_2 e^0$

$y = c - (c - y_0)e^{-\frac{kA}{V}t}$ $y_0 = c - c_2$

$c_2 = c - y_0$

$\lim_{t\to\infty} y = c$

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when u-substitution — one part = der of another part

let $u =$ inside of composite, denominator

$du =$, solve for dx

parts - product $\int \sin^{-1}x\,dx$, $\int \ln x\,dx$

$u =$ L I P E T $\int u\,dv = uv - \int v\,du$

dv, du, v

partial fractions $\int \frac{\quad}{(\;)(\;)}\,dx = \int \frac{A}{(\;)} + \frac{B}{(\;)}$

$\int \frac{x}{x^2-4}\,dx = \int \frac{x}{(x+2)(x-2)}\,dx$

$= \int \frac{A}{x+2} + \frac{B}{x-2}\,dx$

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59. solve$\left(p(t) = \frac{150}{1+e^{4.3-t}}, t\right)$ 125

$P(t) = \frac{m}{1+Ae^{-kmt}}$

$= \frac{150}{1+e^{4.3}\cdot e^{-t}}$

$\frac{dP}{dt} = kP(m-P)$ $km = 1$

$\frac{dP}{dt} = \frac{k}{m}P(m-P)$ $m = 150$

$k = \frac{1}{150}$

$P = \frac{m}{1+Ae^{-\frac{k}{m}mt}}$

$P = \frac{m}{1+Ae^{-kt}}$

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59. $P(t) = \frac{150}{1+e^{4.3-t}}$ $m = 150$

$\frac{dP}{dt} = kP(M-P)$

$= \frac{150}{1+e^{4.3}\cdot e^{-t}}$

$P(t) = \frac{m}{1+Ae^{-kmt}}$

$km = 1$

$k = \frac{1}{150}$

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54. 96.2% y_0 99.5% of y_0

C_{14}

$y = y_0\left(\frac{1}{2}\right)^{\frac{t}{H}}$

$H = 5700$

$y = y_0\left(\frac{1}{2}\right)^{\frac{t}{5700}}$

$y = .995 y_0$

$.995 \cancel{y_0} = \cancel{y_0}\left(\frac{1}{2}\right)^{\frac{t}{5700}}$

$\ln .995 = \frac{t}{5700} \ln .5$

$t = \frac{\ln .995}{\ln .5} 5700$

$t = 41.2$ yrs

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$\int 3x^2(\sin x^3)\,dx$ almost (off by constant)

u-sub: one part is der of another part

$y' = \frac{x}{x^2-4}$ $u =$ bottom or inside of composite
$du =$

parts – product $u =$ LIPET

$\int u\,dv = uv - \int v\,du$ $\int 3x^2 \sin x\,dx$

partial fractions $\frac{x+1}{x^2-4} = \frac{x+1}{(x+2)(x-2)}$

$= \frac{A}{x+2} + \frac{B}{x-2}$

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